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Tuna Scientists Aggregate in Honolulu for 15th SCTB and 1st SCG

John Sibert

Honolulu recently served as the nexus of scientific information on Pacific tuna fisheries by hosting the Fifteenth Meeting of the Standing Committee on Tuna and Billfish (SCTB) from July 18–27, 2002 at the Hawai'i Convention Center. Among the conclusions of the meeting were that:

- the WCPO tuna fishery is the largest in the world, accounting for 49% of the 2001 provisional estimate of global catch (3,900,000 mt) of the four main species;
- stock assessments for yellowfin and bigeye indicate they are likely to be near full exploitation, while skipjack and south pacific albacore appear capable of sustaining current levels of exploitation;
- the catch and fishing mortality of juvenile yellowfin and bigeye have increased greatly over the past decade, arguing against further increases in mortality for these species in the WCPO;
- data collection in general, and particularly for stock assessment in the fisheries of Indonesia and the Philippines, needs to be strengthened; and,
- large-scale conventional tagging of all species is considered critical to provide better information on natural mortality, fishing mortality, movement, and stock structure, while electronic tagging of certain species is needed to provide detailed information on vertical habitat utilization.

SCTB 15— Participants & Papers

SCTB 15 was attended by participants from Australia, Canada, the Cook Islands, the Federated States of Micronesia, Fiji, France, French Polynesia, Indonesia, Korea, the Marshall Islands, New Caledonia, New Zealand, Niue, the Northern Mariana Islands, Palau, Papua New Guinea, the Peoples Republic of China, the Philippines, Samoa, the Solomon Islands, Taiwan, the United States of America, Vanuatu, Vietnam, and Wallis and Futuna. Also attending were representatives from various regional and international organizations, including the Food and Agriculture Organization of the United Nations, the Inter-American Tropical Tuna Commission, the Indian Ocean Tuna Commission, and the Forum Fisheries Agency. SCTB 15 was hosted by the Pelagic Fisheries Research Program and co-sponsored by the Oceanic Fisheries Program of the Secretariat of the Pacific Community, the Western Pacific Regional Fishery Management Council, and the National Marine Fisheries Service, Honolulu Laboratory.

Nearly 120 participants from 25 nations attended SCTB in July, presenting about 100 papers, including national fishing reports from 26 countries.

After an absence of several years, scientists from the Philippines and Indonesia participated once again, and SCTB 15 was pleased to welcome a new participant from Vietnam. Japanese scientists did not participate for the second consecutive year, citing

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SCTB and SCG: A Little History

This year's SCTB meeting was the third to be held in Honolulu; previous meetings were held in 1988 (the inaugural) and in 1997. Following on the heels of the SCTB meeting, a smaller group of scientists gathered for the first meeting of the MHLC's Scientific Coordinating Group (SCG), which was held from July 29–31 at Honolulu's East-West Center.

Since its establishment in 1988, the SCTB has provided a forum for scientists and others to discuss issues related to data, research and stock assessment in the WCPO, and has thereby become the de facto definitive source for information on regional tuna fisheries.

The SCTB also provides informed opinions on the status of stocks and on various other scientific issues. This important role has been recognized by the Preparatory Conference for the Commission on the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific (PrepCon), which in its second session advocated formation of the SCG to provide scientific input for the PrepCon's third session.

their objection to the newly created Convention on the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean (the MHLC convention).

Nevertheless, participants in SCTB 15 presented approximately 100 papers, including national fishing reports from 26 countries; most of these papers are available in electronic form from the PFRP web site: http://imina.soest.Hawai'i.edu/PFRP. Additional information about the SCTB, and papers from previous meetings, can be obtained from the SPC Oceanic Fisheries Programme web site: http://www.spc.int/OceanFish/.

The Fishery: Catch, Supply and Prices[1]

The total WCPO catch of tunas during 2001 was estimated at approximately 1,900,000 metric tons (mt), slightly higher than the 2000 catch but less than the 1998 record high of more than 2,000,000 mt. The purse-seine fishery traditionally accounts for most of the catch (around 1,100,000 mt, or 56% of the total catch in 2001), with pole-and-line taking 300,000 mt (17%), the longline fishery 200,000 mt (13%, and a record for this fishery), and the remainder (14%) by troll gear and a variety of artisanal gears, mostly in eastern Indonesia and the Philippines.

The WCPO tuna fishery is the largest in the world; its catch represented 75% of the total estimated Pacific Ocean catch of 2,500,000 mt in 2001, and 49% of the provisional estimate of the global catch (3,900,000 mt) of the four species. The estimated catch in the Eastern Pacific Ocean (EPO) in 2001 was approximately 650,000 mt, the second highest on record for the region. And the provisional global catch of the four main species for 2001 was the second highest ever (after 1999), increasing by more than 500,000 mt since 1996.

Purse-seine fleets from Taiwan, Japan, Korea, the U.S. and Papua New Guinea account for the largest proportion of the total catch by a wide margin. The provisional 2001 purse-seine catch of 1,100,000 mt was the fourth consecutive annual catch in excess of 1,000,000 mt. This catch level was attained in spite of voluntary reductions in effort as a result of lower prices for cannery-bound tuna during 2000. The recently formed World Tuna Purse Seine Organization (WTPO) has implemented a catch-reduction program to address problems of over-supply and low prices. During the early months of 2001, the situation in the WCPO resulted in an unprecedented move by the entire U.S. purse-seine fleet, which voluntarily stopped fishing throughout January and a part of February. A reduction in effort was also apparent with the Korean and Taiwanese fleets during this period, but not to the extent seen with the U.S. fleet. An increase in skipjack price was achieved in the first quarter of 2001 and continued into 2002.

Recent Trends: FADs, Vessels and Fleets

At previous meetings of the SCTB, scientists expressed concern over the large proportion of juvenile yellowfin and bigeye caught by the purse-seine fishery operating near logs and artificial drifting fish aggregation devices (FADs). Dependence on logs and drifting FADs seems to have decreased, and in 2001 the number of sets on free-swimming schools was larger than the number of sets on either logs or FADs. However, this apparent change in fishing practices may be attributable more to increased efforts to reduce the over-supply of skipjack than to concerns about stock status.

Recent trends in the longline fleet continued through 2001. This fleet is comprised of two distinct classes of vessels. The first class is the large (typically >250 GRT) distant-water freezer vessels that undertake long voyages (months) and operate over large areas of the region; these vessels may target either tropical (yellowfin, bigeye) or subtropical (albacore) species. The second class of longliners is the smaller (typically <100 GRT) offshore vessels that are usually based domestically, possess ice or chill capacity, and serve fresh or air-freight sashimi markets; these vessels operate mostly in tropical areas.

In recent years, the trend has been for contraction of the large-vessel distant-water fleets and growth in the smaller fleets, many of which are based in Pacific islands and target albacore. The 2001 longline catch (240,000 mt) was a record for the WCPO. The species composition of this catch was 35% yellowfin, 35% albacore and 30% bigeye. The bigeye (71,000 mt) and albacore (83,000 mt) catches for 2001 were records for this fishery. The 2001 yellowfin catch (82,870 mt) was the highest catch in nearly 20 years, continuing a significant recovery from the lowest catch recorded for nearly 30 years (56,520 mt in 1999, only two years earlier).

Although most of the 2001 WCPO catch was taken by the large-vessel, distant-water fleets of Japan, Korea and Taiwan, the

[1]Much of this material is abstracted from "Overview Of The Western And Central Pacific Ocean Tuna Fisheries, 2001" by Anthony D. Lewis and Peter G. Williams, SCTB15-Gen 1.

overall proportion of the catch by these fleets is declining. In contrast, the growth in domestic fleets in the South Pacific over recent years has been substantial, with Fiji, Samoa, American Samoa, French Polynesia and New Caledonia as examples. These small-vessel fleets target albacore, and their catch now comprises more than 40% of the South Pacific albacore longline catch.

Condition of WCPO Stocks

Stock assessment at SCTB is handled by four species-specific research groups responsible for skipjack, yellowfin, bigeye and south pacific albacore, plus a catch-all research group for everything else: the Billfish And Bycatch Research Group (BBRG). This arrangement reflects the traditional preoccupation of SCTB with the four principle species of tuna caught in the WCPO. However, since the meeting was held in Honolulu, a substantial part of it was devoted to the BBRG, which heard presentations on by-catch species of concern to the Honolulu-based longline fleet.

In general, the status of the major stocks has changed little over the last year. Skipjack and south pacific albacore stocks both appear to be in good condition and therefore capable of comfortably sustaining current levels of exploitation. The status of yellowfin and bigeye stocks is less certain, and many participants in SCTB 15 said that these two species are close to full exploitation, and that further increases in fishing effort would not increase yield and might over-fish the stocks. SCTB 15 reiterated the recommendation of SCTB 14 that there be no further increase in fishing mortality by the purse-seine fleet for these species in the WCPO.

However, stock assessment science is fraught with uncertainty. In addition to the usual questions about the structural assumptions required by the statistical analysis, the assessments of yellowfin and bigeye are hampered by uncertainties about the data. Large catches of both species are made in Indonesia and the Philippines, but detailed statistics on species composition, size composition and geographic distribution of these catches are not available. These uncertainties emphasize the importance of the SCTB recommendation to not increase efforts that might increase mortality on juvenile yellowfin and bigeye.

Observations and Recommendations

Stock assessments for skipjack, yellowfin and bigeye tunas continue to be hampered by the lack of adequate statistics on catch, effort, size, and species composition for some areas. In particular, data collection in the fisheries of Indonesia and the Philippines needs to be strengthened.

Observer coverage of commercial fishing operations needs to be improved in order to sample the proportion of bigeye and yellowfin in purse-seine catches, to estimate catch rates for non-target species, and to collect size-composition data.

Assessments for yellowfin and bigeye tuna indicate that both stocks are likely to be near full exploitation, in contrast with the skipjack and south pacific albacore stocks, which appear capable of sustaining current levels of exploitation. The catches and fishing mortality of juvenile yellowfin and bigeye have increased greatly over the past decade due primarily to increased catches in Indonesia, the Philippines, and the international purse-seine fishery. SCTB 15 therefore reiterated the recommendation of SCTB 14 that there be no further increase in fishing mortality in surface fisheries for these species in the WCPO.

Increased research and monitoring in several specific areas would lead to improved understanding of WCPO tuna stocks. Considered critical for all species will be large-scale conventional tagging to provide better information on natural mortality, fishing mortality, movement, and stock structure. In addition, state-of-the-art electronic tagging of yellowfin, bigeye and albacore is needed to provide detailed information on vertical habitat utilization, which is used in CPUE standardization studies.

SCG: Informing the Political Process

The Scientific Coordinating Group was established to provide scientific input to the MHLC PrepCon. The goals for this first SCG meeting were to establish guidelines and formats for reporting on stock status, to provide interim scientific advice to the PrepCon on the status of the four primary tuna stocks, and to determine the fisheries and scientific data needs of the PrepCon. The timing of the SCG meeting facilitated attendance by SCTB participants, which assured that the SCG received the best available scientific advice.

In general, the SCG endorsed the findings of the SCTB with respect to the status of stocks. More importantly perhaps, the SCG developed a specific proposal to help Indonesia implement a port-sampling program to supply detailed information on domestic tuna landings. The SCG also reviewed current sources of information on the status of stocks in the WCPO, and concluded that existing regional arrangements for compilation and dissemination of data, coordinated by the SCTB, are suitable for the interim.

Time did not permit the SCG to fully address the question of providing scientific advice to the Commission over the longer term. However, the SCG recognized that the priorities for fisheries data are:

- estimates of annual catches;
- data on catch and effort, preferably on an operational level (e.g. longline and purse-seine sets); and,
- data on size composition (length or weight).

These conclusions and recommendations will be transmitted to the third session of the PrepCon in Manila in November 2002. Meanwhile, the full report of the SCG can be obtained at http://www.ocean-affairs.com/scgrp.html.

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PFRP PIs to Gather in December

The 2002 PFRP PI's Workshop, scheduled for December 4–6 at the University of Hawai'i, will see the debut of 15 new projects that have been funded for 2002–2003. About half of the Workshop will be devoted to presentation of results from current PFRP projects, and the remainder to presentation of the new projects and a discussion of how to "tie one on."

The mini-workshop "Tying One On" is still in development,, but will focus on secure deployment of electronic tags on pelagic animals. Kim Holland is coordinating the workshop, and notes that participants will have a range of backgrounds, including fieldwork with pelagics, biomaterials research, and the physiology of healing wounds; he adds that the workshop format will emphasize roundtable discussion.

Following are the new PFRP projects selected for 2002/03, organized by topic:

Ecosystem-Based Fishery Management

- Comparisons of Catch Rates for Target and Incidentally Taken Fishes in Widely Separated Areas of the Pacific Ocean: W. Walsh and S. Pooley.
- Describing the Spatial Dynamics (Vertical and Horizontal) for Large Pelagics in the Central Pacific Ecosystem with Pop-up Satellite Archival Tags: J. Polovina and M. Seki.
- Evaluating Biochemical and Physiological Predictors of Long Term Survival in Released Pacific Blue Marlin tagged with Pop-up Satellite Archival Transmitters (PSATs): M. Musyl, C. D. Moyes, and R. W. Brill.
- Trophic Structure and Tuna Movement in the Cold Tongue/Warm Pool Pelagic Ecosystem of the Equatorial Pacific: V. Allain, B. Fry, R. Olsen, F. Galvan Magaña, and B. Popp.
- Application of a Continuous Advection-Diffusion Equation to Spatial Mixed Resolution Dynamics Population Models: P. Lehodey.
- Patterns and Causes of Declines in World Billfish Catch Rates: R. Myers and P. Ward.

Integrated Statistical Models of Protected Species Population Dynamics

- Integrated Statistical Model for Hawaiian Albatross Populations: D. Goodman and J-D Lebreton.
- A General Bayesian Integrated Population Dynamics Model for Protected Species: M. Maunder.
- Development of a Hierarchical Model to Estimate Sea Turtle Rookery Contributions to Mixed Stocks in Foraging Habitats: B. Bolker, K. Bjorndal and A. Bolten.
- Direct Tests of the Efficacy of Bait and Gear Modifications for Reducing Interactions of Sea Turtles in Costa Rica: Y. Swimmer, R. Brill, C. Boggs, M. McCracken, and R. Arauz.

Management of Southern Albacore Fisheries

- Ecological Characterization of American Samoa's Small-Scale Alia Albacore Longline Fishery (Sentinal Monitoring of the American Samoa Small-Scale Longline Fishery): J. Kaneko, P. Bartram, and T. Beeching.
- Oceanographic Characterization of the American Samoa Longline Fishing Grounds for Albacore, *Thunnus alalunga*: M. Seki and J. Polovina.

Dynamics of Tuna Aggregation

- Instrumented Buoys as Autonomous Observatories of Pelagic Ecosystems: K. Holland and L. Dagorn.

Social Sciences

- A Sociological Baseline of Hawai'i's Longline Fishery: S. Pooley and S. Allen.
- Modeling Longline Effort Dynamics and Protected Species Interaction: P. Leung, N. Pradhan, and S. Pooley.

For more details on the 2002 PFRP PI meeting, please contact Dodie Lau (dlau@soest.hawaii.edu) or John Sibert (jsibert@soest.hawaii.edu), or consult the PFRP web site (http://imina.soest.hawaii.edu/PFRP/).

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PrepCon 3 to Meet in Manila

The third session of the Preparatory Conference for the Commission for the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific will meet in Manila, Philippines from November 18–22, 2002— and the results of the meeting are likely to definitively shape the Commission.

To be discussed for the first time are issues related to enforcement of fisheries regulations, or MCS (monitoring control and surveillance). The scientific structure of the Commission will also be a prominent subject on the agenda, and the Conference will probably make some important decisions on how the Commission will conduct its scientific affairs. The agenda also includes discussions of budget and finance, Commission rules of procedure, and staffing.

Finally, the Conference will examine competing bids to host the Commission headquarters, submitted by the Federated States of Micronesia, the Independent State of Papua New Guinea, the Kingdom of Tonga and the Philippines. More information about the Commission and Preparatory Conference can be found at http://www.ocean-affairs.com/.

Status of Yellowfin Tuna in the Western and Central Pacific

John Hampton

*Yellowfin tuna (*Thunnus albacares*) have a long history of exploitation in the Western and Central Pacific Ocean (WCPO). In the 1960s and 1970s, longliners (mainly Japanese) dominated the fishery. In the 1980s, purse seining began in the WCPO and catches increased dramatically (Figure 1). Also, the development of domestic fisheries in the Philippines and Indonesia (which make up the majority of the "other" component in Figures 1 and 2) have also contributed to increased catches in the past 25 years. The catch is distributed over a wide area of the WCPO, but is concentrated in the equatorial zone where the purse seine fishery operates (Figure 2). This summary report[1] describes a stock assessment model for yellowfin tuna in the WCPO, and outlines the assessment results obtained from a preliminary reference point analysis.*

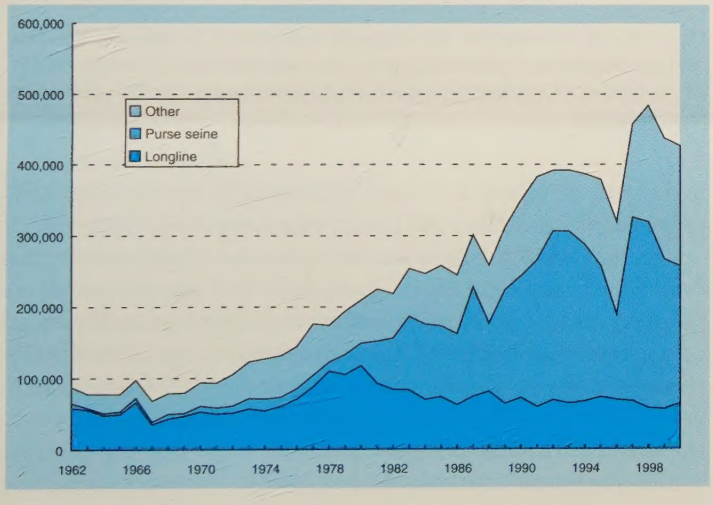

Figure 1. Catch (in tons) of yellowfin tuna in the WCPO.

The Population Model

With funding support from the Pelagic Fisheries Research Program, a population model for yellowfin tuna has been developed using the MULTIFAN-CL approach (Hampton and Fournier 2001). The model is age and spatially structured, and is fitted to size composition data (length and weight frequency), tagging data and catch and effort data. Total fishing effort is stratified into a number of "fisheries," each of which is allowed to have different selectivity (with respect to fish age) and catchability characteristics. Selectivity is assumed to be constant over time, but catchability is allowed to vary over time for some fisheries. The fisheries defined in the yellowfin model are as follows:

	Region	Gear
1	1	Longline
2	2	Longline
3	3	Longline
4	4	Longline
5	5	Longline
6	2	Purse seine log sets
7	2	Purse seine FAD sets
8	2	Purse seine school sets
9	3	Purse seine log sets
10	3	Purse seine FAD sets
11	3	Purse seine school sets
12	2	Philippines miscellaneous
13	2	Philippines handline
14	2	Indonesia miscellaneous
15	4	Australia longline

Assumptions and Parameters

There is a large amount of flexibility in defining the model structure in a MULTIFAN-CL-based analysis. Some of the more important assumptions used in this yellowfin tuna analysis are:

Spatial structure:	5 regions as per Figure 2
Time stratification:	1962-2001, by quarter
Age structure:	20 quarterly age classes
Recruitment:	Occurs quarterly and in each region independently

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[1]This paper is a summary of a more detailed report presented to the 15th meeting of the Standing Committee on Tuna and Billfish (Honolulu, Hawaii, 22-27 July 2002). The full report is available at: http://www.spc.int/OceanFish/Html/SCTB/SCTB15/YFT-1.pdf.

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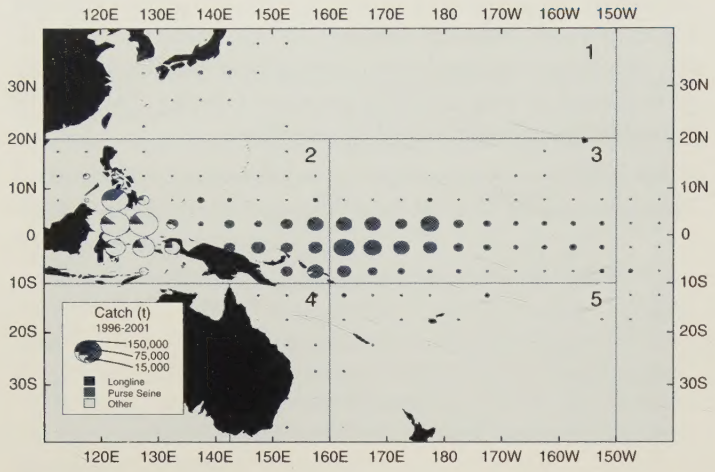

Figure 2. Geographical distribution of yellowfin tuna catch, 1996-2001. The five regions used in the assessment model are shown.

Growth:	Age-classes 1-8 have independent mean lengths, 9-20 follow von Bertalanffy growth; weight-length parameters specified
Catchability:	Constant over time and among regions for the longline fisheries, variable over time/regions for other fisheries
Selectivity:	Constant over time and among regions for longline fisheries and purse seine fisheries of the same set type
Stock-recruitment:	Constrained by a prior for "steepness" such that significant (>10%) recruitment decline occurs at adult biomass <20% of virgin levels
Natural mortality rates:	Age-dependent, constant among regions and over time
Movement rates:	Age- and region-dependent, constant over time

The model is parameterized by fitting to total catch estimates stratified by fishery and time period, length-frequency data (where available), weight-frequency data (where available) and tagging data. The catch data are assumed to be accurately observed and the model is forced to fit catches with high precision. The contribution of the length- and weight-frequency data to the objective function is determined largely by sample size and information on the coverage of sampling for the various fisheries. The tagging data are modeled using a negative binomial likelihood function. Additional information is introduced into the model by way of penalties and constraints on various parameters for which prior information is available.

Stock Assessment Results

We can compile the model results in various ways in order to assess the status of the stock. The population biomass (blue line in Figure 3A) is estimated to have increased in the late 1970s, peaking

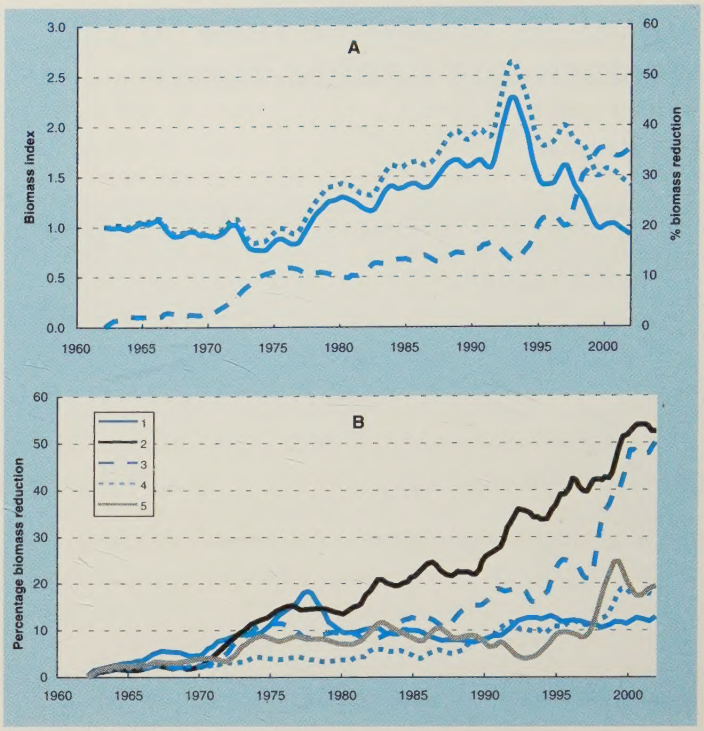

Figure 3. (A) Estimates of biomass with and without fishing and the percentage reduction in biomass from the unfished level for the WCPO. (B) Estimates of percentage reductions in biomass for the five individual model regions.

in the mid-1990s and declining thereafter. The current biomass is estimated at similar levels to the early period of the fishery.

The impact of the fisheries on the biomass is estimated by the difference between the biomass estimated with the observed level of fishing and the biomass estimated with fishing mortality set to zero (dotted line in Figure 3A). According to the model results, the biomass in the most recent time periods is reduced by approximately 35% from the level it would have been had fishing never occurred (dashed line in Figure 3A).

These measures of fishery impact refer to the entire stock area. However, the distribution of catches (Figure 2) suggests that impacts might be higher in the tropical regions. Indeed, the estimates of biomass reduction for the tropical regions of the model (2 and 3) are around 50% in recent periods, whereas impacts for the sub-tropical regions (4 and 5) are <20% (Figure 3B).

MSY-Based Reference Points

The use of reference points provides a framework for quantitatively determining the status of the stock and its exploitation level. Two types of reference points are often now required for fisheries management: the fishing mortality at maximum sustainable yield (F_{MSY}) is used as an indicator of overfishing; and the biomass at MSY (B_{MSY}) is used as an indicator of an overfished state. It is likely that these reference points, or something similar, will be used for stock status determinations in the

new WCPO tuna commission. We have therefore developed a reference point analysis within the MULTIFAN-CL model framework as an example of how this might be applied in WCPO tuna fisheries.

The reference point analysis has been carried out as follows:

1. Estimate population model parameters, including the parameters of a Beverton and Holt stock-recruitment relationship (SRR).
2. Estimate a "base" age-specific fishing mortality vector, F_{age}, various multiples of which are assumed to be maintained into the future; for the yellowfin tuna assessment, the average F_{age} over 1996-2000 was used.
3. For various multiples of F_{age} compute the equilibrium population-at-age, and equilibrium yield using the estimated SRR, natural mortality and other parameters.
4. Compute the equilibrium total biomass, equilibrium adult biomass and equilibrium fishing mortality (averaged over age classes) at MSY. These equilibrium quantities are the reference points.
5. Compare the actual estimated biomass and fishing mortality levels at time *t* with these reference points. This is done by computing the ratios $B_t^{total}/B_{MSY}^{total}$, $B_t^{adult}/B_{MSY}^{adult}$, F_t/F_{MSY} and their 95% confidence intervals and comparing them with 1.0. Values of F_t/F_{MSY} significantly greater than 1.0 would indicate overfishing, while values of $B_t^{total}/B_{MSY}^{total}$ and/or $B_t^{adult}/B_{MSY}^{adult}$ of less than 1.0 would indicate an overfished state.

Note that these somewhat simplistic notions make assumptions about equilibrium behaviour of the populations. This aspect of reference points, and in particular those based on equilibrium models, has been roundly criticised (with some justification) in some fisheries circles. One criticism is that long-term changes in recruitment might occur through environmental or ecosystem changes that have little or nothing to do with the fisheries. More generally, it is not unreasonable to view many fish populations as being in a continual state of flux with an equilibrium condition never being reached or maintained for any length of time. In reality, therefore, MSY, F_{MSY} and B_{MSY} are "moving targets" and not static quantities. At best, they should be considered as averages over time, and additional analyses undertaken in cases where it is suspected that important non-fishery-induced changes in productivity may have occurred.

Caveats and Biases

The estimated equilibrium yield using a base *F*-at-age given by the 1996-2000 average is shown in Figure 4. This analysis indicates that, at the 1996-2000 average *F*-at-age (i.e. a fishing mortality multiplier of 1.0), the equilibrium yield is approximately 300,000 t per year. The maximum equilibrium yield (equivalent to MSY) of about 365,000 t is achieved at a F-multiplier of 2. These equilibrium yields are considerably lower than the actual catches that

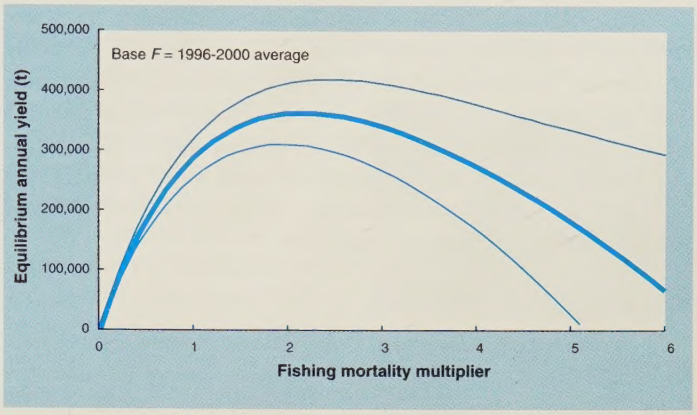

Figure 4. Equilibrium annual yield as a function of fishing mortality, with 95% confidence intervals.

occurred during 1996-2000, which averaged about 425,000 t per year. Does this mean that overfishing is occurring? Not according to this model, which attributes high recent catches to recent recruitment being considerably higher than both the long-term average recruitment and the equilibrium recruitment predicted by the SRR. This underlines the equilibrium nature of the reference point analysis, which in its present form uses only a single SRR to predict equilibrium recruitment in spite of the fact that multiple environmentally-driven recruitment phases may occur for some species. For yellowfin tuna, there is some indication that a high-recruitment phase has occurred post-1975. Had the yield analysis been conducted using a SRR based on this period, then the predicted yields would have been higher and more consistent with recent catches.

Recruitment effects such as noted above can bias status determinations based on a comparison of catch and MSY. A comparison of *F* with F_{MSY} is better from this point of view as the effects of recruitment are removed. The ratios of F_t/F_{MSY} and $B_t^{adult}/B_{MSY}^{adult}$ are shown in Figure 5. F_t/F_{MSY} has been beneath the overfishing reference point throughout the time series. Also, while adult biomass has fallen recently, $B_t^{adult}/B_{MSY}^{adult}$ has remained above 1.0, indicating that the population has yet to reach an overfished state under the definition used here.

A Conclusion and Cautionary Notes

On the basis of the reference point analysis, we would conclude that yellowfin tuna is not currently overexploited in the WCPO. However, it is necessary to add two notes of caution. First, while overall MSY-based reference points are not exceeded, the model results show that the tropical regions are more heavily exploited than the WCPO as a whole. Such sub-regional differences in exploitation will need to be considered in future management regimes. Secondly, models such as MULTIFAN-CL are relatively data intensive and depend on accurate fishery statistics (as do all fishery models). For much of the WCPO, the

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tuna fisheries data are of a high standard. However, the data available for the large catches (around 30% of the WCPO total) of relatively small tuna in the domestic fisheries of Philippines and Indonesia are considerably uncertain and errors in the data could significantly influence the assessment results. Tuna fisheries data collection in this region will need to be strengthened and this is likely to be a priority of the new WCPO Tuna Commission when it comes into force.

References

Hampton, J., and Fournier, D.A. 2001. A spatially disaggregated, length-based, age-structured population model of yellowfin tuna (Thunnus albacares) in the Western and Central Pacific Ocean. Marine and Freshwater Research 52: 937–963.

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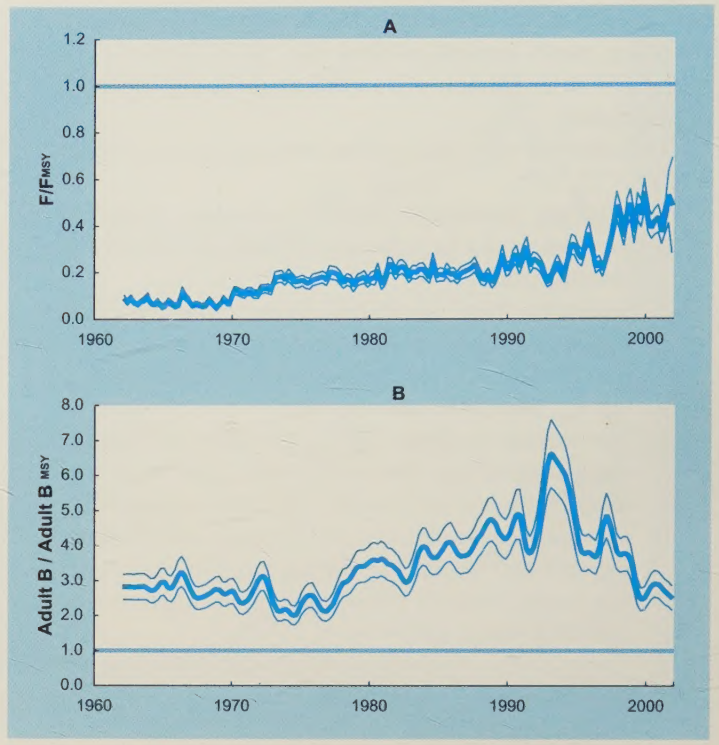

Figure 5. Ratios of (A) F_t/F_{MSY} and $B_t^{adult}/B_{MSY}^{adult}$ with 95% confidence intervals. The horizontal lines at 1.0 in each case indicate the overfishing (A) and overfished state (B) reference points.

Fisheries Research in Brief

DNA Test to I.D. Shark Fins

A new genetic test may help pinpoint the shark species that are most at risk of finning, and help police the widely banned practice as well.

According to conservation geneticist Mahmood Shivji of the Guy Harvey Research Institute in Fort Lauderdale, Florida, it is almost impossible to identify the species of a disembodied shark fin. So Shivji and colleagues developed a DNA test to determine the species of a fin, and with it identified 75 dried shark fins from the Hong Kong commercal market.

As of August 2002, the team had DNA fingerprints for blue, dusky, porbeagle, silky, and longfin and shortfin makos, which are commonly found on the global market. Shivji plans further testing to expand the coverage to the 35 species of shark that are most commonly fished, and believes the test is fast and simple enough for conservation agencies to use.

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(see Shivji, M., et al. Genetic identification of pelagic shark body parts for conservation and trade monitoring. Conservation Biology, 16, 1-13, (2002))

Abstract: Status of the U. S. Western Pacific Tuna Purse Seine Fleet[1]

Robert Gillett, Mike A. McCoy, and David G. Itano

This study focuses on aspects of the dynamics of the United States tuna purse seine fleet, and is intended to increase the information available for management of Western Pacific tuna resources. The authors review the fleet's history, describe major interest groups, and discuss various factors affecting its operation, as well as forces influencing its future. To carry out the study, the authors supplemented their experience with and knowledge of the U.S. fleet with interviews of numerous important stakeholders, including present and past U.S. vessel owners and managers, fishing vessel operators, representatives of several tuna processing companies, representatives of the U.S. tuna industry, and tuna fishery managers.

U.S. purse seiner in Pago Pago harbor.

Study Topics and Analysis

Specific topics addressed are:

- the movement of the fleet from the Eastern Pacific to the Western Pacific;
- fishing patterns;
- specifications of the fleet;
- stakeholders in the fleet; and,
- major issues confronting the fleet.

The study analyzes positive and negative factors affecting the fleet, and identifies the most important threats to its survival; it also views current issues in light of how the fleet coped with previous threats from the mid-1950s to the late 1980s.

Information about the future of the U.S. fleet is conceptually divided into three categories:

- opinions expressed by other studies and individuals;
- assertions that can be made with some degree of confidence; and,
- speculation based on information in this report and other sources.

Viability of the Fleet

The authors subsequently explore the management implications of both a declining fleet and the demise of the fleet. Four major factors are described as threatening the continued viability of the fleet: (1) low or stagnant prices; (2) the fleet's high costs of production; (3) the reduction of advantages for basing in American Samoa; and (4) the underlying threat of a lack of generational continuity in vessel-owning families.

The dock at Starkist Cannery in Pago Pago.

With respect to the fleet's future, many of the factors causing the downward trend in U.S. vessel numbers will probably persist. Conversely, a recent change in a trade arrangement with Andean Pact countries will have a favorable impact on the fleet. Most of the events that have had a major effect on the U.S. fleet in the past (both negative and positive) have been largely unexpected.

Fleet Ownership and Coping with Change

In the longer term, the composition of the fleet with respect to ownership is likely to evolve and be made up of more corporate-owned vessels and vessels owned by individuals who have other than strictly financial reasons to stay involved in the industry. This change may be similar to what has occurred in U.S. agriculture, with its continued evolution from family-owned farms to corporate, or agribusiness ownership.

The study also describes the management implications of two possible change scenarios for the U.S. fleet, and identifies as some of the most likely consequences:

- the entry of additional fleets into the Western Pacific and a consequent increase in overall effort in the fishery;
- degradation of the quality of fisheries data and flag state responsibility; and,
- increases in FAD-related fishing.

Finally, several indicators point strongly to the U.S. Government continuing its role in management of the Western Pacific tuna fishery should its purse seine fleet cease to exist; these indicators include experience in the Eastern Pacific, where the U.S. fleet is no longer active.

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This report was prepared in August 2002 for the Pelagic Fisheries Research Program at the University of Hawai'i. Robert Gillett and Mike McCoy are a Fiji-based Director and a Kona, Hawai'i-based Associate, respectively, at Gillett, Preston and Associates, which provides consulting services for fishery and marine resource assessment, as well as development and management projects. David Itano is a Research Associate with the PFRP in Honolulu, and can be reached at ditano@iniki.soest.hawaii.edu. Gillett can be reached at gillett@connect.com.fj, and McCoy at mmc@aloha.net.

[1]This report is available in its entirety as a PFRP Technical Report: SOEST Publication #02-01 / JIMAR Publication #02-344.

MHLC— Evaluation and Comment

Anna Willock

Following is the fifth in a series of commentaries on the Multilateral High-level Conference on the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific (MHLC). The goal of this series is to share the evaluations of scientists and other parties who are well informed about the MHLC, its Convention and evolving Commission, in the hope that continued frank discussion can contribute to the most effective and mutually agreeable implementation of the Convention.

We have accepted the assessments of persons recommended as knowledgeable about MHLC and are seeking additional comment. Our principal criteria are that contributors are familiar with the proceedings, the science and the proposed management schemes, and are willing to answer the same questions, with an opportunity for open comment.

Comments, questions, and requests for inclusion as a contributor may be addressed to Editor, PFRP News, MSB 313, 1000 Pope Road, Honolulu, Hawai'i 96822, or e-mailed to andercox@hawaii.rr.com, or jsibert@soest.hawaii.edu.

General Questions

1. *MHLC conferences attempted to resolve international concerns and develop a formal means of managing Highly Migratory Fish Stocks in the Western and Central Pacific. Do you feel this goal was achieved by the conferences? Why or why not?*

While the MHLC process has not in itself resolved international concerns relating to stocks in the broader Western and Central Pacific Ocean, it has resulted in development of a fairly detailed framework through which it is now possible to address such concerns as they arise. The need for such a formal structure, enabling both conservation and management of highly migratory fish stocks on the high seas, and integration with measures implemented by Pacific Coastal States, has long been recognized in the region, including in the 1979 convention establishing the Forum Fisheries Agency.

With regard to science, there already existed well-developed processes for cooperating on research in the region, particularly through the activities of the Oceanic Fisheries Programme. However, adoption of the new Convention now moves the provision of scientific advice into a more formal (and political) setting as the Convention mandates action to be taken based on this advice.

2. *Do you feel MHLC7 was a good conclusion to these meetings? Why or why not?*

Perhaps the most positive outcome of MHLC7 was that the Convention was adopted. The final text is disappointing in that it contains unwelcome compromises in a number of important areas, including the chambered voting system, the reversal of the onus of proof in relation to port states' ability to prohibit landings or transshipments of catches in their ports, and the potential for conflict to emerge between management arrangements north of 20°N and those in the rest of the Convention area. Nevertheless, the fact that a number of countries, at the conclusion of the conference, were moving away from previous agreements, made it likely that further negotiating sessions would have resulted in further weakening of the text.

MHLC7 clearly drew to a close the first stage in development of a conservation and management regime for the broader Western and Central Pacific—yet much of the momentum and good will generated by earlier negotiating sessions was lost in doing so. MHLC7 created a great deal of frustration and dissatisfaction on the part of many participants, particularly in reaction to the eleventh-hour changes to decision-making provisions, and the refusal by some participants to agree to adoption of the final text.

3. *Should there be an MHLC8, and if so, what should be addressed at this meeting?*

The question of whether there should be an MHLC8 has already been superceded by the holding of two Preparatory Conferences. The creation at Preparatory Conference I of a working group devoted to considering scientific issues, including technical concerns and mechanisms for the delivery of science, was very welcome. This removed the risk that resolution of scientific issues would be overshadowed by administrative and budgetary considerations, which are being discussed in a separate working group.

Specific Questions Regarding MHLC

1. *In terms of research and data gathering, what advantages do you feel the MHLC Convention has over other conventions dealing with highly migratory fish stocks (e.g., IATTC, IOTC, ICCAT, CCSBT)?*

The MHLC Convention had the advantage of being negotiated after the adoption of the United Nations Fish Stocks Agreement (UNFSA). This meant that detailed guidelines and obligations relating to data collection and research for highly migratory fish stocks had already been agreed to at an international level. While there was still a high level of debate over some of these obligations, the UNFSA provisions provided a solid basis upon which to develop the MHLC text.

A further advantage of the MHLC Convention is that it draws on the experience under other conventions – both negative and positive. As an example, the explicit ability of the MHLC Commission to engage independent scientific experts to provide it with advice is a major advantage over some other conventions, and a step toward trying to ensure that science is not politicized.

A key advantage for the success of research and data gathering under the MHLC Convention is that the region already has well-

established institutions and cooperative mechanisms for this purpose, providing a sound basis for developing the detail of protocols specified under the Convention.

2. *What are the disadvantages of the MHLC Convention with regard to data collection and research?*

It is probably a little early in the life of the Convention to identify weaknesses related to data collection and research; any such weaknesses are more likely to emerge once the arrangements have been fully tested against practical and political considerations. Discussions at the first meeting of the Scientific Coordinating Group, held in late July 2002, should quickly identify deficiencies in the text.

However, one potential disadvantage in the Convention as it stands relates to the engagement of scientific experts, whose involvement is not mandatory and so is open to debate. The potential purview of the independent experts is also fairly wide, which raises budgetary considerations. A point related to budgetary considerations is that Coastal States will need to balance the level of resources devoted to in-zone research with those devoted to regional research. This is an important consideration for small island countries and the regional organizations that support their in-zone research needs.

3. *What do you consider to be the major obstacles facing the scientific arrangements associated with the Commission?*

While not so much an "obstacle," the Commission (and its supporting scientific arrangements) will need to be structured to ensure that there is not a myopic focus on the four main tuna stocks at the expense of other issues of increasing international concern; these include bycatch of sharks and turtles, and development of ecosystem-based approaches to management. Related to this will be the need to continue developing innovative approaches to scientific research and analysis in the region, while at the same time ensuring that such research remains relevant to the questions that will need to be answered to develop management responses within the context of the Convention. This will rely in part on scientists being able to communicate effectively to the Commission the relevance of innovative work.

4. *What do you consider to be the major obstacles facing the MHLC Commission over the next few years?*

A major pragmatic factor facing the future Commission will be acquisition of adequate funding for the range of activities under its mandate. Given the geopolitical nature of the region, donor organizations will most likely be forced to decide where to direct limited funds, including how to divide funds between support for existing regional institutions and obligations under the new Commission.

The absence of Japan in the Preparatory Conferences is also a concern; Japan's positive contribution to the future Commission will be important to its success, not only because Japan is a major distant-water fishing nation and Coastal State under the Convention, but also because it possesses well-established expertise in scientific research.

Finally, the issue of allocation of fishing effort or catch has already appeared on the horizon. A major challenge for the MHLC Commission will be to avoid the implosion being experienced in other fisheries organizations over this issue, which has left them almost paralyzed and so unable to address other conservation and management issues.

5. *In the wake of MHLC7, how will management of high-seas fisheries in the Western and Central Pacific change over the next ten years?*

Ten years is a relatively short time frame for a Convention that is not yet in force. However, the fact that there will be a forum to discuss and make binding decisions on management of the high seas will in itself be a major change in the region.

The current global impetus to address the problems of illegal, unregulated and unreported fishing should have major repercussions for the Western and Central Pacific. In particular, over the next ten years the notion of "freedom of fishing" hopefully will be further qualified through legal challenges and more extensive accession to the UNFSA. Resolution of allocation issues in the region should also affect the high seas by providing part of the solution to unregulated fishing.

With regard to the form that management measures may take, trade-related and market-based measures are emerging as a tool to supplement at-sea monitoring, control and surveillance within regimes dealing with high seas fisheries— and it is likely that we will see some form of certification or documentation developed in the Western and Central Pacific to address what will be similar problems in this region.

6. *As far as scientific research is concerned, what needs to be done during the approximately 3 years of Preparatory Conferences that take place between adoption of the text and enactment of the Convention?*

The Preparatory Conferences' expectations for scientific research are reasonably clearly set out in the terms of reference for the working group on scientific structure and provision of interim scientific advice. It will be essential that agreements are reached during this period on the means of delivery of scientific advice to the Commission, and on protocols for the collection and organization of data. Furthermore, the working group has also been asked to delineate a process by which the Preparatory Conference can receive advice on the status of the four main tuna stocks. This

(continued on page 12)

links with Resolution I of MHLC, which enables the Preparatory Conference to recommend conservation and management measures for the stocks prior to the Convention coming into force. Although any such measures would only be applied on a voluntary basis, such a mandate is crucial given the concerns about the status of yellowfin and bigeye that have emerged in recent meetings of the Standing Committee on Tuna and Billfish. To place any such advice on the status of stocks in context will also require the development of reference points (both target and limit) for at least each of the key tuna stocks.

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